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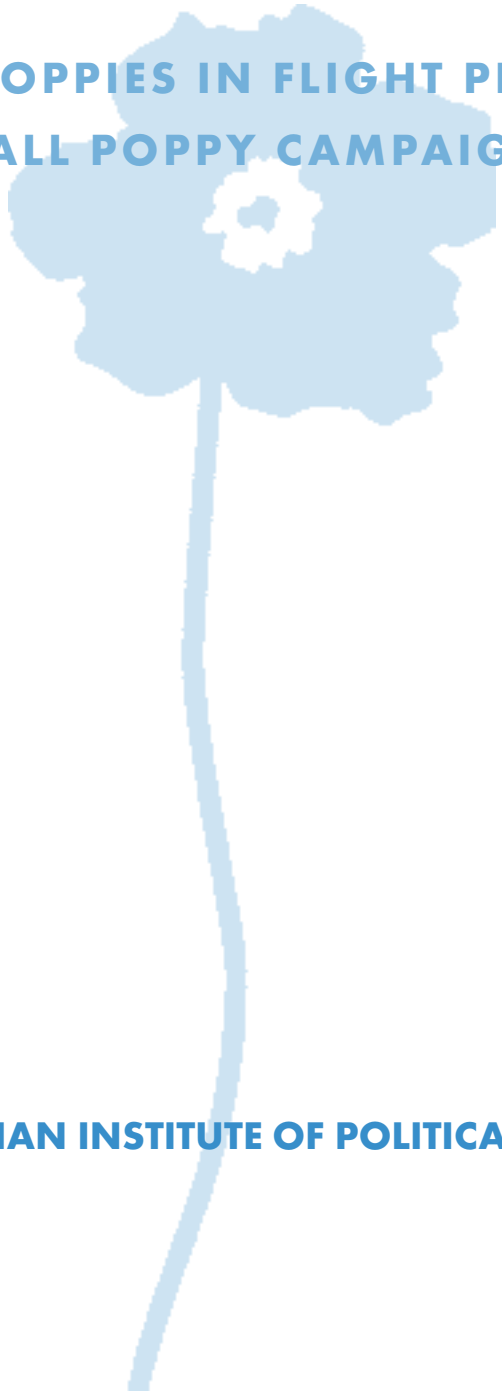
Young Tall Poppy Science HEROES

TALL POPPIES IN FLIGHT PROJECT

TALL POPPY CAMPAIGN



AUSTRALIAN INSTITUTE OF POLITICAL SCIENCE

The Tall Poppies in Flight is a national science education project for children in upper primary schools.

The project is part of the Tall Poppy Campaign which aims to promote Australia's science heroes, both past and present, to inspire young people in the pursuit of intellectual excellence by promoting a greater appreciation of the achievements of all our Tall Poppies and to encourage younger Australians to follow in their footsteps.

The Tall Poppy Campaign is an inititative of the Australian Institute of Political Science. The Institute is an independent non-partisan organisation which was established in 1932 to promote broader understanding of political, economic and social issues in Australia.

Funding for this project is supplied by the Commonwealth Department of Health and Ageing.

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Preface

The chapters in this book are based on the work and experiments of 9 outstanding young Australian researchers, winners of the Young Tall Poppy Science Awards across different States.

The Young Tall Poppy Science Awards recognise outstanding scholarship and achievements from young scientific researchers with up to 10 years post-doctoral experience.

The Young Tall Poppy Science Award recipients share their passion for their work, their intrigue with science and their latest research with primary and secondary school students and teachers across the country.

The Young Tall Poppies who have contributed to this book come from NSW, Victoria, South Australia and Queensland. They have devised experiments and investigations to allow children to explore the wonderful world of science – from studies on hearts, lungs, bones, hearing and allergies – to exciting engineering and environmental activities. Always, the scientists are asking questions, making observations, creating hypotheses and suggesting further ideas for learning and understanding.

We would like to take this opportunity to thank the Young Tall Poppy Award recipients who have contributed to this book for their fantastic efforts!

John Beale has worked with the material provided by the Young Tall Poppies on their work to ensure that it can be used safely, productively and enthusiastically by young students. John Beale believes passionately in the value of teaching science to anyone who will listen, particularly young people. He currently teaches psychology and statistics at university, has a PHD in Nuclear Physics and is working on a second PHD in Psychology.

The activities are written to allow students to carry out independant or group investigations. It is important that we recognise that scientists often work collaboratively – not only with colleagues from the same institution, but also with other scientists who share the same interest and curiosity from all over the world.

The following experiments and activities involve the use of flammable materials and are inherently subject to risk of danger and injury. Accordingly, care must be taken to follow the instructions appropriately and to conduct the relevant activities in an appropriate area where any risk of damage of, or danger to, any individual or property is removed. The activities must also be undertaken with appropriate adult supervision. Neither the Australian Institute of Political Science (AIPS) nor any other person affiliated with these materials is responsible or assumes any liability for any damage, injury or death resulting from pursuit of the following activities and in pursuing the following activities you release and indemnify AIPS from any claim in relation to any such matter.

Alfio Parisi, PhD

My parents migrated to Australia and I was born in 1959 at Mossman, in North Queensland. I attended primary school in Mossman, which was a small sugar town, where my family lived close to the local sugar mill. A vivid memory of those days living in the tropics was the carefree and barefoot times, with the soot from the sugar mill covering anything that was stationary.

During secondary school at Trinity Bay State High School in Cairns, I was interested in how and why technology works. I was always keen to pull apart anything that was not working with the aim of seeing the 'insides'. Studying science provided me with the avenues to explore these interests. In senior high school, the physics classes provided explanation of the basic laws and principles of science that underlie modern science and technology.

Combining this with the ethics of hard work, provided by my family, gave me the motivation to study physics at James Cook University and to continue work as a Physicist. Following graduation, my first employment was in Canberra as a marine geophysicist exploring for oil and gas hidden below the seas off Australia.

I now work as a physics lecturer at a university and research solar ultraviolet radiation. I became interested in solar ultraviolet radiation as a research field in order to understand the laws of physics that influence solar ultraviolet radiation. The motivation was to understand the factors that influence ultraviolet radiation exposure to humans during normal daily activities. The risks of skin cancers and sun-related eye problems like cataracts are increased by ultraviolet exposure and in order to reduce these risks, an understanding of the solar ultraviolet radiation is essential.

During my career as a Physicist and scientist, I have been an author on a book, written my research findings in scientific journals, travelled to overseas scientific conferences and never lost my interest and excitement for science and physics in particular.

Ultraviolet Radiation

The risk of developing skin cancer or sun-related eye disorders may be lowered by the reduction of human exposures to solar ultraviolet (UV) radiation. There are also other determining factors such as genetic factors, however, both the total amount of sun received over the years, and over exposure resulting in sunburn increase the risk of skin cancer.

There is a need to balance harmful UV exposure against the benefits of exposure which include the production of vitamin D. This requires an understanding of the solar UV environment.

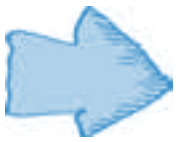
The solar UV that reaches the earth's atmosphere is made up of wavelengths shorter than 400 nanometres or nm (where 1 nm is one thousand millionth of a meter). These wavelengths are shorter and carry more energy than the wavelengths of visible light. The UV is divided into the categories of UVC (shorter than 280 nm), UVB (280 to 320 nm) and UVA (320 to 400 nm).

At the surface of the earth, there is no solar UVC present and only part of the solar UVB. This reduction of the solar UV is due to the earth's atmosphere absorbing and scattering the radiation. Absorption by ozone and oxygen molecules in the atmosphere removes all the UVC. Part of the UVB is absorbed by ozone. It is the UVB that will increase if there are any reductions in the amount of ozone in the atmosphere. At the longer UVA wavelengths, there is very little absorption by ozone, so that changes in ozone are of no consequence for the UVA.

Cloud cover significantly affects the amount of UV reaching the surface of the earth. This amount also depends on how far the UV from the sun must travel through the earth's atmosphere and this depends on the angle of the sun above the horizon. This varies with time of day and with season. The scattering of UV in the atmosphere is the result of the interaction with molecules and particles suspended in the air. Any particle in the UV radiation's path causes redirection of the UV. This scattering of the UV means that even in shade there is a percentage of UV present.

INVESTIGATION ONE

Degradation caused by UV



You will need

Page of newspaper
Board
Tape
Access to the Internet
Best done as a class

Procedure

Pick a period, preferably in summer where the weather forecast is for several days without rain. Cut the page of a newspaper in half. Tape one piece to the board and place it on an unshaded outdoor surface. Keep the other piece indoors in a cupboard drawer.

At the end of the first day compare the colour of the two sheets of paper. What has happened to the sheet placed outdoors? Repeat the process for a second day and again compare the sheet that has been outdoors to the sheet that has been indoors.

Write a brief report describing what happened to the newspaper and why you think it happened.

INVESTIGATION TWO

UV index

You will need

Access to the Internet

This can be done individually or in small groups

Procedure

1. The UV index is provided by the Bureau of Meteorology to describe the daily levels of solar UV radiation. It is a forecast value that indicates the forecast maximum for the day.
2. Visit the Bureau's website and find the map of Australia with the forecast clear sky UV index for local noon marked on it. The web address is: http://www.bom.gov.au/info/about_uvb.shtml
3. What is the forecast clear sky index for your area today?
4. On that same web page there is a table describing the danger category for the relevant UV index. What is the danger category for the UV index for today?
5. On this web page, follow the link "See UV Index Forecast Graphs for Capital Cities and Alice Springs."
6. Find the graph for the capital city closest to your location.
7. What is the UV index two hours either side of midday and three hours either side of midday?
8. How does it compare with midday and how does the danger category compare with midday?
9. Display your results in a table.

INVESTIGATION THREE

UV in tree shade

You will need

The Ultra-Violet Sensometer. This is a small index card that undergoes a colour change to provide a reading of the UV levels in the three categories of weak, medium and strong. It is available through the South Seas Trading Company, Maui, Hawaii for $4.95US plus postage and handling at the web address: http://www.maui.net/~southsky/uvcard2.html

Best done in small groups.

Procedure

1. Take the card outside and obtain a reading on a horizontal plane of the UV level at 9 am. What is the reading?
2. Repeat this at approximately noon.

3. At noon, take the card into tree shade and take a reading on a horizontal plane.
4. How does this compare with that in full sun?
5. The reading in the tree shade should be less than in full sun, however there may have still been some UV in the tree shade due to the UV that has been scattered by the molecules and particles in the atmosphere and that is reaching us from all directions.

INVESTIGATION FOUR

Ozone hole

You will need

Access to the Internet

Best done in small groups.

Procedure

One of the methods of measuring the ozone levels in the atmosphere is by satellite. The data is available on the web site below: http://jwocky.gsfc.nasa.gov/

1. On this site, on the left hand column, click on ozone. When this next page has loaded, select south pole image – GIF (640 x 480) and select a date at the start of any year and press request to obtain an image of the ozone levels over the south pole and southern hemisphere.
2. If there is a blank patch over the South Pole, select another date. What is the average ozone level over the South Pole?
3. Select a date in the middle of the year. What is the average ozone level over the South Pole.
4. Select a date in September or October and what is the average ozone level over the South Pole.
5. You may have found that the ozone levels are lower over the South Pole in spring. This is because in winter the temperatures over Antarctica are extremely cold and trigger a series of chemical reactions that lead to the rapid destruction of ozone and the low levels of ozone in spring.
6. Make a table of your results.

FURTHER WORK

Using the school library and the Internet, research the causes of the hole in the ozone layer. Prepare a set of about 10 questions you would use to interview the president of the United States on the measures his country is taking to limit the size of the hole in the ozone layer. Write a report of the results of your research, listing your questions and saying why each question is important.

Prepare a poster showing the methods we should all adopt to minimise the damage to our bodies from too much ultraviolet radiation.